



Correlation between Barthel Index based on dyspnea (BI-d), COPD Assessment test (CAT), BODE and GOLD classification as a staging system of COPD.

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Abstract: Chronic Obstructive Pulmonary Disease (COPD) is common, preventable and treatable disease is characterized by persistent respiratory symptoms like dyspnea and airflow limitations. There are many objective and subjective scales which are used to assess different factors affected due to COPD like quality of life, well-being of patients, dyspnea, endurance, etc. GOLD is diagnostic criteria for diagnosis as well as for assessment of COPD. Barthel Index based on dyspnea, COPD assessment test and BODE are used to assess the dyspnea, wellbeing of patients, endurance and mortality of patients respectively in patients. To study the Correlation between Barthel Index based on dyspnea (BI-d), COPD assessment test (CAT), BODE and GOLD classification as staging systems of COPD was the aim of this study.

Methodology- With the help of convenient sampling 23 COPD patients were taken as a sample. PFT was performed for all the samples and according to PFT results their disease staging was determined. All the patients were given validated BI-d and CAT scales in their preferred language. BI-d measures level of dyspnea perceived in performing Activities of Daily living and rate from 0-4 for per activity and total score is from 0-100. CAT examines well-being of patients and scoring of scale is from 0-40. For BODE index, BMI, obstruction i.e. FEV1 obtained from PFT, dyspnea from mMRC scale and Endurance from 6-minute walk test was performed and value of BODE index score from 0-10 was given. Through SPSS software all the results were analyzed and spearman's correlation coefficient test was used.

Results- At significance level of 0.05, correlation done between GOLD and BI-d had strength of correlation of 0.52 which was moderate positive correlation. Rho values was 0.01 hence GOLD and BI-d positively correlates and statistically significant. Correlation done between GOLD and CAT had strength of correlation of 0.13 which was weak positive correlation while rho value was 0.51 at same significance level. This was statistically not significant. Correlation between GOLD and BODE had strength of correlation of 0.91 which was strong positive correlation and p value was 0.00001. GOLD and BODE had statistically significant positive correlation.

Conclusion- BODE, BI-d, CAT all these positively correlates with GOLD but CAT doesn't show significant positive correlation.

1. INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a common, preventable and treatable disease that is characterized by persistent respiratory symptoms and airflow limitations due to airway and/or alveolar abnormalities usually caused by significant exposure to noxious particles or gases¹. It can be related to retained secretions, inflammation of the mucosal lining of airway walls, bronchial constriction related to increased tone or spasm of bronchial smooth muscle or weakening of the support structure of airway walls. All of these increase the resistance to expiratory airflow. Therefore, it results in incomplete emptying of the lungs².

In 2016, there were 251 million cases of COPD in the world and it is estimated that COPD causes 3.15 million deaths per year³. As on 2016, three out of five leading cause of mortalities constitute non-communicable diseases; whereas COPD is the second biggest cause of death in India⁴. It contributes very significantly to mortality from COPD of around 102.3/100,000 thus significantly affecting health related quality of life in the country¹.

COPD causes many physiological changes like reduction in elastic recoil, significant airway narrowing with airflow reduction and air trapping in lungs. The fibrotic remodeling causes fixed airway narrowing which increases airway resistance. It also decreases surface of alveoli for gaseous exchange and leads to ventilation circulation mismatch⁵⁻⁷. The pathophysiological consequences of COPD causes series of physiological changes which eventually impact quality of life of patients⁵.

Barthel Index based on dyspnea (BI-d), COPD assessment test and BODE index are used to assess the dyspnea, wellbeing of patients, and mortality of patients respectively in patients.

The Barthel Index based on dyspnea perception provides to be reliable and sensitive tool for measuring the level of dyspnea perceived during performing of basic daily living activities. This unique instrument developed for chronic patients and long-term hospital patients. It simultaneously provides a global assessment of disability during ADLs, and incorporates both motor and respiratory aspects. Both inter-rater and test retest reliability ICC was 0.93 and 0.99 respectively. The internal consistency measured with Cronbach's alpha was 0.89. Barthel Index Scale based on dyspnea examines eleven daily activities which are Grooming, Bathing, Feeding, Toilet use, Stairs, Dressing, Bowels, Bladder, Mobility, Wheelchair and Transfers; last two activities to be used only if patient is not able to do independent mobility⁸. Examining their performance affected by dyspnea it is rated between 0= no sign of dyspnea and 4= extreme severe level of dyspnea. The total BI-d scores range from 0(no dyspnea) to 100(maximum dyspnea)⁸.

COPD Assessment test (CAT) is a validated questionnaire about wellbeing of patient⁹. CAT is a short, simple, patient-completed questionnaire for assessing and monitoring COPD¹⁰. It consists of eight items, which includes: cough, phlegm, chest tightness, and breathlessness going up hills / stairs, activity limitation at home, confidence of leaving home, sleep and energy. It covers a broad range of effect of COPD on patient's health, despite the small number of components items. CAT's internal consistency show that it provides a reliable measure of overall COPD severity from patient's perspective, independent of language. Items of CAT were tested for differential functioning between countries. Internal consistency was excellent; Cronbach's alpha = 0.88. Intra-class correlation coefficient was 0.8. Correlation with COPD- specific version of the St George's Respiratory Questionnaire is $r=0.80$; Hence, CAT has good measurement properties. It is sensitive to differences in state and provide a valid and reliable and standardized method to measure of COPD health status. Total CAT scores are from 0-40^{9,10}.

BODE multidimensional index based on four relevant variables related to COPD mortality that involves both pulmonary and systemic factors: body mass index (B), airflow obstruction (O) for degree of obstruction, dyspnea (D) and exercise capacity (E)¹¹. The BODE index that captures the multidimensional manifestations of COPD is a valuable tool not only in the assessment of severity (staging) and progression of disease, but also in evaluating the response to medical interventions. BODE is also better predictor of mortality for COPD patients than the classical variable (FEV1) alone. Beside the BODE index is easily applicable. The 6-min walk test (6MWT) is a marker for the exercise capacity of COPD patients in BODE index. BODE index score is from 0 to 10, All four dimensions of BODE are divided into 4 variables from 0 to 3 and scores of all dimensions from 0-3 are added together¹¹. BODE is also better than FEV1 in predicting the hospitalization for COPD¹² as well as number and severity of exacerbation in COPD patients¹³

Global Initiative for Chronic Obstructive Lung Disease, GOLD is a program to produce recommendations for diagnosis, management and prevention of COPD based on the best scientific information available. The aim of the GOLD report is to provide a non-biased review of the current evidence for the assessment, diagnosis and treatment of patients with COPD. According to 2018 report of GOLD criteria, patients having $FEV1/FVC < 0.70$ post bronchodilator are diagnosed as COPD and divided into four stages according to airflow limitation i.e. FEV1¹.

To study the Correlation between Barthel Index based on dyspnea (BI-d), COPD assessment test (CAT), BODE and GOLD was the aim of this study to understand which test correlates better with GOLD classification as a staging system of COPD.

Abbreviations and Acronyms

- COPD- Chronic Obstructive Pulmonary Disease
- BI-d- Barthel Index Based on Dyspnea
- CAT- COPD Assessment Test.
- GOLD- Global Initiative for Chronic Obstructive Lung Disease
- PFT- Pulmonary Function test
- FEV1- Forced Expiratory Volume in One second
- FVC- Forced Vital Capacity
- ADL's- Activities of Daily Living

2. RESEARCH METHODOLOGY

2.1 Population and Sample

Calculated sample size was 26. Patients diagnosed with COPD according to GOLD criteria were included.

All the patients were informed about study. Consent form was given to patients who fit into inclusion criteria and willing to participate in study. Samples who were in acute exacerbation, unstable cardiovascular condition or hemodynamically unstable or samples with any neuromuscular disorder in which sample is unable to ambulate were excluded.

23 samples were included in study, couldn't complete the sample size.

2.2 Data and Sources of Data

All the samples were collected from tertiary health care centers.

2.3 Theoretical framework

- FVC: Forced expiratory vital capacity, in this person first inspires maximally to the total lung capacity, and then exhales into the spirometer with maximum respiratory effort as rapidly and as completely as possible¹⁴.
- FEV1: Forced expiratory volume during the first second¹⁴.
- BI-d: Barthel Index based on dyspnea. In this, eleven activities include and patient will give scoring on 1 to 4-point scale according to dyspnea faced during particular activity of daily living⁸.
- CAT: COPD assessment test. This is patient completed questionnaire assessing all aspects of impact of COPD. There are eight questions on 1 to 5-point scale¹⁰.
- BODE: B=BMI, O= airway Obstruction, D=Dyspnea, E=Endurance. Airway obstruction will be calculated with the help of PFT. Dyspnea is measure according to Modified medical research council scale (MMRC) and endurance by Six-minute walk test¹¹.

All the included samples were explained about the PFT and how to perform it. PFT (heliyos 401) was used, according to the results and GOLD criteria, the stage of COPD was determined. During PFT was performed examiner checked that the patient had a proper posture, nose-clip was in appropriate place, and the lips were sealed around the mouthpiece. Instructions to take maximum inspiration, blow forcefully as hard as possible for 15 second until there is nothing to expel and continued with maximum inspiration were given. All the instructions were in patients prefer language and maneuver was performed and shown to patient for better understanding¹⁵.

For assessment of CAT all the subjects were given CAT scale to fill, which was given according to their preferred language either in English, Marathi or Hindi¹⁶. All the translated scales were validated. Grading system of CAT is from 0-40 and questions are about different aspects. Total score given by patient was calculated and recorded.

For BI-d, examiner explained the subjects about grading system from 1-4. Patients were asked about the dyspnea experienced during the activities given in scale. According to grading given by patients, total score was calculated and recorded.

For BODE index information of age, gender was obtained. The Body Mass Index (BMI) was calculated as the weight in kilograms divided by height in square meters. Dyspnea was evaluated using mMRC (modified Medical Research Council) scale¹¹.

Subjects were given the instructions and information about 6-min walk test and test was performed. Before starting with 6-minute walk test patients were checked for contraindications given by ATS guidelines¹⁵. The patient was made to sit at rest in a chair, located near the starting position, for at least 10 minutes before starting the test. During this time, pulse and blood pressure was checked, and made sure that clothing and shoes were appropriate. Then patients were made to walk on 30m distance corridor. All the instructions were given to patients according to ATS guidelines¹⁵. Patient was asked to cover maximum distance in 6 minutes. Encouragement was not given to patients. Patients were allowed to take rest pause. At the end of test total distance covered by patients in 6minute was calculated. Vital parameters like heart rate, respiratory rate, blood pressure, dyspnea by RPE & oxygen saturation were taken before starting the test. Same parameters taken immediately after the test& after 1, 3, 5 minutes respectively¹⁵.

2.4 Statistical tools

SPSS software was used to analyze data. Spearman's correlation coefficient test was used.

2.4.1 Descriptive Statistics

Descriptive statistics to find maximum, minimum, standard deviation and mean is calculated by using SPSS software.

All the descriptive study data is given in Table no. 1

3. RESULTS AND DISCUSSION

4.1 Results of Descriptive Statics of Study Variables

Table 1

Variable	Minimum	Maximum	Mean	Std. Deviation
Age (years)	45	81	60.6	12.6
BI-d	2	36	15.7	8.6
CAT	4	30	19.5	7.9
BODE	0	6	2.3	2
GOLD	1	4	2	0.9

In 23 samples maximum patients were from age of 45 to 65. Mean age was 60. In 23 samples 13 patients were male and 10 were female.

According to statistical analysis done, all three tests had a positive correlation with GOLD classification as staging system of COPD but CAT had weak positive correlation which wasn't statistically significant.

Correlation done between GOLD and BI-d –

Strength of correlation was 0.52 which is moderate positive correlation. Rho values was 0.01 at significance level of 0.05. This is statistically significant. (Table 2)

Figure 1 shows the correlation graph for GOLD and BI-d.

Correlation between GOLD and CAT-

Strength of correlation was 0.13 which is weak positive correlation while rho value was 0.51 at same significance level. This is statistically not significant. (Table 2)

Figure 2 is showing correlation graph of GOLD and CAT.

Correlation between GOLD and BODE-

In this outcome measure strength of correlation was 0.91 which is strong positive correlation and rho value is 0.00001 which is statistically significant. (Table 2)

Figure 3 shows correlation graph of GOLD and BODE.

Table 2

Correlation between	Rho value	P value	S/NS
GOLD- BI-d	0.52	0.01	S
GOLD-CAT	0.13	0.5	NS
GOLD-BODE	0.91	0.00001	S

(S – Statistically Significant)

NS – Not Statistically Significant)

In COPD and other respiratory dysfunctions, dyspnea is a major symptom. Dyspnea is mainly due to increased work of breathing which leads to increase in oxygen consumption and hence it affects activities of daily living as well as quality of life. Relief from dyspnea during Activities of Daily Living (ADLs) represents the major goal of respiratory rehabilitation and its quantification through specific instruments (scales) is essential to define disability level and post-rehabilitation improvement¹⁷. Approximately 40% of patients with Chronic Obstructive Pulmonary Disease report a degree of disability and 68% lose at least one relevant function in daily life⁹. With the worsening of disease there is progressive decrease in ability to perform ADL⁹. As peripheral oxygen saturation decreases it leads to dyspnea⁵. Oxygen desaturation occurs during activities like walking, washing etc. Thus, onset of dyspnea limits these activities that is activities of daily living⁶. As disease worsens it will lead to more dyspnea due to airflow limitations, lower peripheral oxygen saturation, flattening of diaphragm, increased work of breathing as well as atrophy of peripheral muscles and fatigue. All these factors lead to difficulties in performing ADL's¹⁸.

BI-d consists of all ADL like bathing, grooming, toilet use, dressing, stair case climbing, eating etc. As disease will progress patient will face difficulty to perform all these ADL's. Disease progressions is based on airflow limitation which is tested by FEV1 with the of PFT⁸. Hence as disease progresses, FEV1 reduces due to increased airflow limitation which leads to increased dyspnea. It will compromise patient's ability to perform ADL's¹⁸.

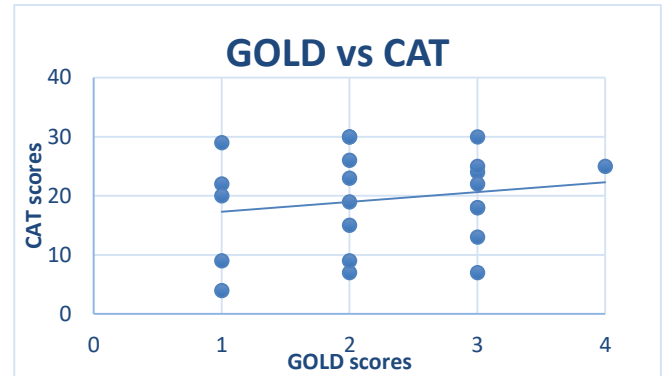
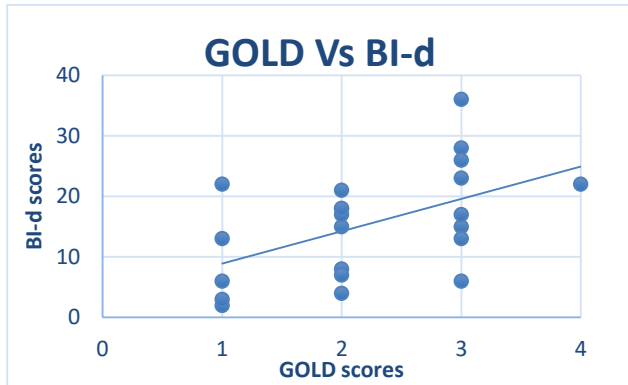
All the parameters of BODE, BMI, FEV1 i.e. obstruction, Dyspnea by MMRC and endurance testing with 6-minute walk distance are positively and well correlated with FEV1¹⁸⁻²⁰. Therefore, it is explanatory to have positive correlation between BODE and GOLD.

CAT gives us about wellbeing of patient and CAT is subjective questionnaire. In this study patients with acute exacerbation were excluded and CAT questionnaire is symptoms dependent scale. As patients were not in exacerbation, severity of their symptoms was less and this could be the possible reasoning for having non-significant correlation.

One more possible reason for not significant results could be unequal distribution patients in all four stages of GOLD staging system of COPD.

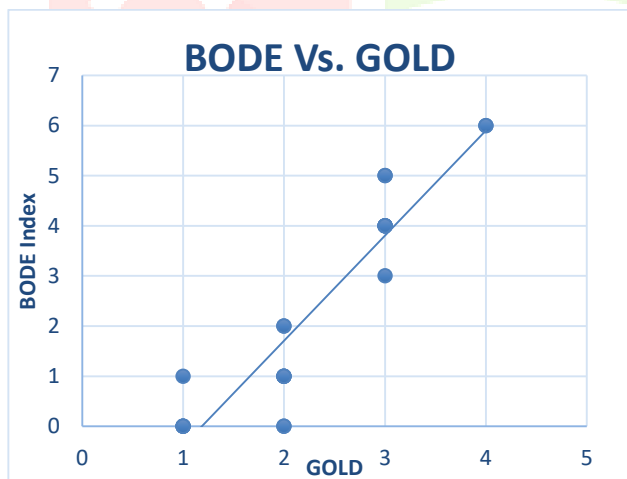
In this study Correlation between tests with respect to each grade of GOLD was not taken into consideration, Total sample size was not completed and COPD phenotypes wasn't considered while taking sample. These are limitations of study. Further study with considering COPD phenotypes can be future scope of this study.

Figures-



“Fig 1”
 on X axis: 1 unit = 1 Gold score,
 on Y axis: 1 unit= 5 BI-d score.
 Positive correlation between BI-d and GOLD, $\rho=0.52$.
 P value is 0.01-significant results

“Fig 2”
 on X axis: 1 unit = 1 Gold score,
 on Y axis: 1 unit= 5 CAT score
 Positive correlation between CAT and GOLD, $\rho= 0.13$.
 P value was 0.5- non significant



“Fig 3”
 on X axis: 1 unit = 1 Gold score, on Y axis: 1 unit= 1 BODE score
 Positive correlation between BODE and GOLD, $\rho= 0.91$
 P value was 0.00001- significant.

Conclusion-

BODE, BI-d, CAT all these positively correlates with GOLD (0.91, 0.52, 0.13) respectively; but CAT doesn't show significant positive correlation and BODE index is better correlating with GOLD as a staging system of COPD.

BODE and BI-d should be used more frequently in clinical practice.

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